CLAIMS

What is claimed is:

1. In a wireless node location mechanism comprising a plurality of radio transceivers operative to detect the signal strength of signals transmitted by wireless nodes; wherein at least one of the radio transceivers comprises a plurality of directional antennas, a method comprising

detecting, at at least some of the plurality of radio transceivers, the signal strength of RF signals transmitted by a wireless node;

as to the infrastructure radio transceivers comprising a plurality of directional antennas, detecting the strength of the RF signals transduced by at least one of the plurality of directional antennas; and

computing the estimated location of the wireless node using at least some of the signal strengths of the RF signals detected by the infrastructure radios, and knowledge of the antennas used to detect the signal strengths of the RF signals.

2. The method of claim 1 wherein the computing step comprises

identifying the directional antennas associated with the signal strengths to be used in locating the wireless node;

selecting aspects of an RF physical model associated with the identified directional antennas;

computing the estimated location of the wireless node using the signal strengths of the RF signals detected by the infrastructure radios, and the selected aspects of the physical model.

3. The method of claim 2 wherein the aspects of the RF physical model are coverage maps corresponding to respective antennas, wherein at least one of the antennas is a directional antenna.

4. The method of claim 3 wherein the coverage maps each comprise a plurality of location coordinates associated with corresponding signal strength values.

5. The method of claim 4 wherein the coverage maps are heuristically constructed.

6. The method of claim 4 wherein the coverage maps are based on a mathematical model.

7. An apparatus facilitating the location of a wireless node in an RF environment, comprising

a plurality of radio transceivers comprising at least one antenna, the plurality of radio transceivers operative to detect the strength of signals transmitted by wireless nodes and provide the detected signal strengths to a wireless node location model;

wherein at least one of the radio transceivers comprises at least two directional antennas, and is operative to identify the directional antenna associated with the detected signal strength for a given signal;

a wireless node location model operative to compute the estimated location of a wireless node based on the antennas identified by at least some of the radio transceivers, and the strength of signals transmitted by the wireless node as detected by a plurality of radio transceivers.

8. The apparatus of claim 7 wherein the wireless node location model comprise a plurality of coverage maps corresponding to the antennas associated with the plurality of radio transceivers, the coverage maps including signal strength values for different locations in a physical region.

9. A wireless network system facilitating the location of a wireless node, comprising

a plurality of access elements for wireless communication with at least one remote client element and for communication with a central control element;

wherein the access elements are each operative to

establish and maintain, in connection with a central control element, wireless connections with remote client elements;

detect the strength of received signals;

append a signal strength value to frames received from wireless nodes; and

transmit received frames to a central control element;

wherein at least one of the access elements comprises a plurality of directional antennas, and is further operative to:

select one from the plurality of the directional antennas to receive the frames in received signals;

append an identifier corresponding to the selected antenna to the frames received from the wireless nodes;

at least one central control element for supervising the access elements, wherein the central control element is operative to

manage wireless connections between the access elements and corresponding remote client elements, and

store signal strength data appended to frames transmitted by the plurality of access elements in association with wireless node identifiers; and

a wireless node location module operative to

compute the estimated location of a wireless node based on the antennas identified by at least one of the access elements, and the signal strength values appended to the frames transmitted by the wireless node as detected by the access elements.

10. The system of claim 9 wherein the wireless node location module resides in a network management system.

11. The system of claim 9 wherein the wireless node location module resides in the central control element.

12. The system of claim 9 wherein the wireless node location module maintains a signal strength matrix including values representing the strength of signals detected between the access elements.

13. The system of claim 9 wherein the peak gains of the plurality of directional antennas connected to an access element are offset relative to each other.

14. The system of claim 9 wherein the at least one access element further comprises

a switch operatively connected to the plurality of directional antennas and operative to switch between the antennas in response to control signals;

a detector operative to detect at least one signal attribute of the signals transduced the antennas; and

an antenna selection module operative, during receipt of the preamble of a wireless frame, to

provide control signals to the switch designating a selected antenna,

evaluate signal attributes provided by the detector,

select an antenna from the plurality of antennas for receiving the signal associated with the wireless frame.

15. The system of claim 13 wherein the at least one access element further comprises a radio module operatively connected to the switch for receiving signals from one of the plurality of antennas selected by the antenna selection module.

16. The system of claim 14 wherein the radio module is operative to demodulate the received signals into digital data streams.

17. The system of claim 15 further comprising a data link control unit operative to process the digital data streams and identify frames from the digital data streams.

18. The system of claim 9 wherein at least one directional antenna is a patch antenna.

19. The system of claim 9 wherein at least one directional antenna is a yagi antenna.

20. The system of claim 9 wherein at least one directional antenna is a parabolic antenna.

21. The system of claim 9 wherein the plurality of directional antennas are configured to maximize the coverage area provided by the plurality of directional antennas.

22. The system of claim 9 wherein the plurality of directional antennas are configured to provide radio frequency coverage in all directions.

23. The system of claim 13 wherein the switch, in a listen mode, is operative to switch between the antennas before a wireless frame is detected.

24. In a wireless network system comprising a plurality of radio transceivers, at least some of which comprise a plurality of directional antennas, wherein the peak gains of the antennas are offset relative to each other, a method comprising

detecting, at one of the radio transceivers, a signal transduced by one of the directional antennas, wherein the signal transmits a wireless frame, the wireless frame including a preamble;

during receipt of the preamble of the frame, selecting one from the plurality of the antennas based on at least one attribute of the respective signals transduced by the antennas;

switching to the selected antenna for receipt of the remainder of the frame;

appending the detected signal strength and an identifier for the selected antenna to the frame; and

transmitting the frame to a wireless node location module.

25. The method of claim 24 further comprising

repeating the detecting, selecting, switching, appending and transmitting steps for a desired number of radio transceivers; and

computing the estimated location of a wireless node based on the antenna identifiers and signal strength values appended to the frames transmitted by the wireless node as detected by the radio transceivers.

26. A wireless network system facilitating the location of a wireless node, comprising

a plurality of radio transceivers for communication with a wireless node location module;

wherein the radio transceivers are each operative to

detect the strength of received signals encoding frames transmitted by wireless nodes;

append a signal strength value to frames received from the wireless nodes; and

transmit received frames to a wireless node location module;

wherein at least one of the radio transceivers comprises a plurality of directional antennas, and is further operative to:

select one from the plurality of the directional antennas to receive the frames in received signals;

append an identifier corresponding to the selected antenna to the frames received from the wireless nodes;

a wireless node location module operative to

store signal strength data appended to frames transmitted by the plurality of radio transceivers in association with wireless node identifiers; and

compute the estimated location of a wireless node based on the antennas identified by at least one of the access elements, and the signal strength values appended to the frames transmitted by the wireless node as detected by the access elements.

27. The system of claim 26 wherein the frames are 802.11 frames.

28. The system of claim 27 wherein the wireless node identifiers are MAC addresses.

29. In a wireless node location mechanism comprising a plurality of radio transceivers operative to detect the signal strength of signals transmitted by wireless nodes; wherein at least one of the radio transceivers comprises a plurality of directional antennas, a method comprising

receiving, from at least some of the plurality of radio transceivers, the detected signal strength of RF signals transmitted by a wireless node;

as to the infrastructure radio transceivers comprising a plurality of directional antennas, receiving the strength of the RF signals transduced by at least one of the plurality of directional antennas; and

computing the estimated location of the wireless node using at least some of the signal strengths of the RF signals detected by the infrastructure radios, and knowledge of the antennas used to detect the signal strengths of the RF signals.

30. The method of claim 29 wherein the computing step comprises

identifying the directional antennas associated with the signal strengths to be used in locating the wireless node;

selecting aspects of an RF physical model associated with the identified directional antennas;

computing the estimated location of the wireless node using the signal strengths of the RF signals detected by the infrastructure radios, and the selected aspects of the physical model.

31. The method of claim 30 wherein the aspects of the RF physical model are coverage maps corresponding to respective antennas, wherein at least one of the antennas is a directional antenna.

32. The method of claim 31 wherein the coverage maps each comprise a plurality of location coordinates associated with corresponding signal strength values.

33. The method of claim 32 wherein the coverage maps are heuristically constructed.

34. The method of claim 32 wherein the coverage maps are based on a mathematical model.

35. A wireless node location mechanism operating in association with a wireless network environment comprising a plurality of radio transceivers operative to detect the signal strength of signals transmitted by wireless nodes; wherein at

least one of the radio transceivers comprises a plurality of directional antennas, comprising:

a wireless node location module operative to

receive, from at least some of the plurality of radio transceivers, the detected signal strength of RF signals transmitted by a wireless node;

as to the infrastructure radio transceivers comprising a plurality of directional antennas, receive the strength of the RF signals transduced by at least one of the plurality of directional antennas; and

compute the estimated location of the wireless node using at least some of the signal strengths of the RF signals detected by the infrastructure radios, and knowledge of the antennas used to detect the signal strengths of the RF signals.